NEW FOSSIL CRINOIDS (ARTICULATA: COMATULIDA) FROM THE LATE OLIGOCENE OF WAITETE BAY, NORTHERN COROMANDEL PENINSULA, NEW ZEALAND

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Abstract. A new family, two new genera and two new species of articulate crinoids are described from the late Oligocene Torehina Formation at Waitete Bay, Coromandel Peninsula, North Island, New Zealand. The two species of New Zealand Cenozoic tropiometrids lived with stalked crinoids in a shallow, innershelf marine environment no deeper than 30 m. This runs counter to suggestions from the Northern Hemisphere that stalked crinoids moved offshore to deeper water in the Triassic. Both extinct species belong to an extant superfamily today found in warm waters of the Pacific Ocean. The Waitete Bay taxa are so far the only recorded evidence of fossil comatulid communities in New Zealand.

KEYWORDS: Articulata; comatulid; Pseudoconometridae n. fam.; Conometridae; *Moanametra* n. gen.; *Pseudoconometra* n. gen.; Oligocene; Duntroonian; Chattian; Torehina Formation.

INTRODUCTION

While visiting Waitete Bay, northern Coromandel Peninsula, in the early 1970s, Geoff Gillard collected fossilised columnals of the sessile stemmed crinoid *Neilsenicrinus waiteteensis* Eagle, 1993 and other fossil echinoderm fragments, including a comatulid centrodorsal. These were collected from a sandy, flaggy limestone outcrop exposed in a new road-cutting c.15 m above Waitete Bay Beach, near the Waitete Bay settlement. The fossil locality is part of the Torehina Formation (Kear 1955) of late Oligocene age, near the Duntroonian (Chattian)-Waitakian boundary (Eagle & Hayward 1993, Eagle 1993). Subsequent field work during late November 1995 yielded further echinoderm material, including the centrodorsal of another comatulid. These fossil comatulids, the first to be described from New Zealand, are the subject of this paper. A summary and map of the regional and Waitete Bay coastal geology is given in Eagle & Hayward (1993). A localised geological map and stratigraphic column for the Oligocene Torehina Formation comatulid fossil locality is shown in Fig. 1. Eagle & Hayward (1993) provide a palaeontological and palaeoenviromental assessment of the macrofauna found at this fossil locality. All taxa appear *in situ.*

Specimens collected from site number S10/f10 with numbers prefixed "AK" are lodged in the marine invertebrates type collection of the Auckland War Memorial Museum. Crinoid classification and nomenclature follows those used by Clark (1931), Rasmussen (1961), Rasmussen & Sieverts-Doreck (1978), Breimer (1978), Ubaghs (1978), and Messing (1997). Since the *Treatise on Invertebrate Paleontology* (Rasmussen & Sieverts-Doreck 1978), comatulid higher-level classification has been modified by Simms (1988), Milsom *et al.* (1994) and Meyer (1997).

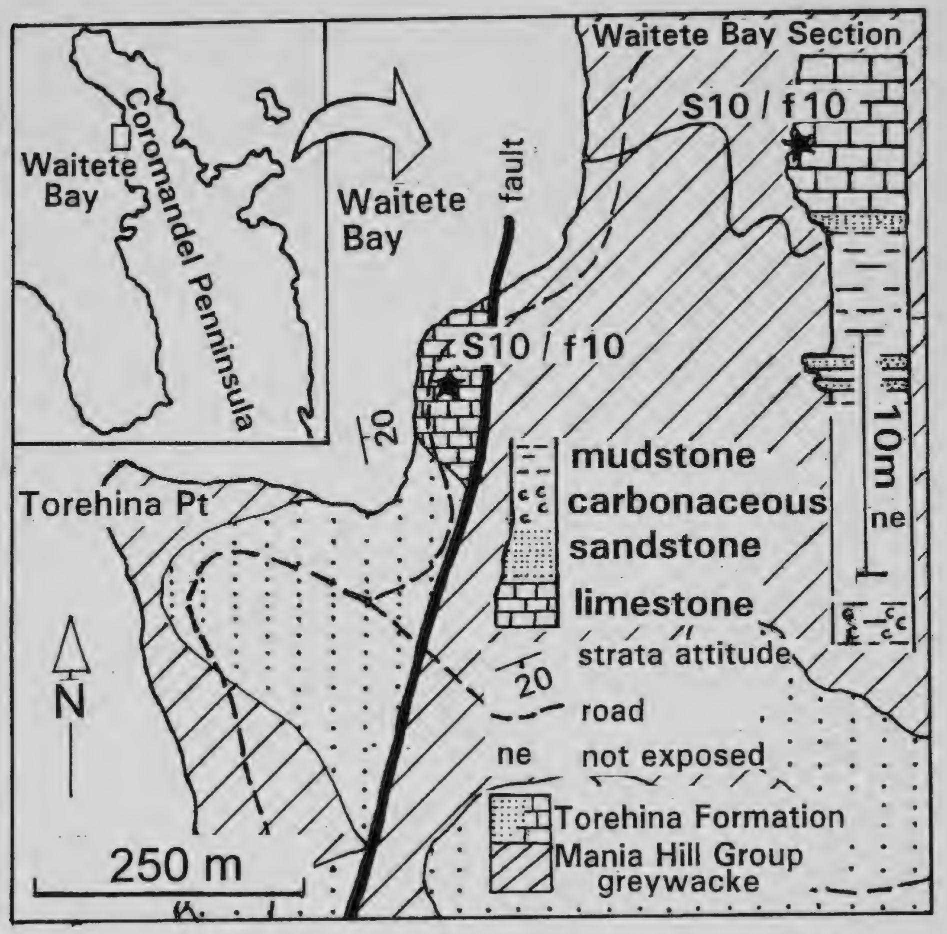


Fig. 1. Localised geological map and stratigraphic column in the immediate vicinity of the late Oligocene Torehina Formation comatulid fossil locality (after Eagle & Hayward 1993).

TYPE LOCALITY AND AGE

All the new species described in this paper have the following type locality and age. Fossil Record File number S10/f10; grid reference S10/289010 (NZMS 260 1:50 000), Torehina Formation (Kear 1955), Waitete Bay, Coromandel, New Zealand (Fig. 1). Duntroonian (Ld) (Chattian), late Oligocene (Eagle 1993, Eagle & Hayward 1993).

SYSTEMATICS

CLASS:	CRINOIDEA Millar, 1821
SUBCLASS:	ARTICULATA Zittel, 1879
ORDER:	COMATULIDA A.H. Clark, 1908
INFRAORDER:	COMATULIDIA Simms, 1988
SUPERFAMILY:	TROPIOMETRACEA A.H. Clark, 1908

Pseudoconometridae n. fam.

Stratigraphic range. Late Oligocene (Duntroonian-Chattian).

Diagnosis. Centrodorsal conical, ventral face circular with five radial pits, five indistinct basal furrows; dorsal with large cirrus-free area without dorsal star. Centrodorsal covered in 15 vertical columns of 7-10 cirrus sockets without ornament, with central, large, circular axial canal; sockets separated by smooth, radial, interradial ridges in rounded section.

REMARKS

Fossil genera resembling modern Tropiometracea in the form of centrodorsals, radials and arrangement of cirrus sockets, are included in this family. Clarke (1915) assigned the Tropiometridae to the Oligophreata, based on the relatively small size of the centrodorsal cavity, but Gislén (1924) and Rasmussen & Sieverts-Doreck (1978) consider the distinction neither natural nor sharp (Messing 1997).

Allocation of the Pseudoconometridae to the Tropiometracea is based on morphological similarity with families already taxonomically grouped within the superfamily. The pseudoconometrid centrodorsal is similar to that of the Conometridae Gislén, 1924, (in particular the genera *Conometra* Gislén, 1924 and *Amphorometra* Gislén, 1924), and similar to one species of *Jaekelometra* Gislén, 1924 of the Paracomatulidae = Paracomaulacea Hess, 1951. Although genera of the Pseudoconometridae, Conometridae, and sometimes Atelecrinidae Bather, 1899 possess tiered lateral circlets of cirrus sockets, only the Psuedoconometridae and Conometridae are without distinct ornament or with feeble articular tubercles. The Atelecrinidae, in particular *Jaekelometra*, has cirrus sockets with a more or less distinct fulcral ridge or articulating tubercles. The number and vertical arrangement of cirrus sockets in these families differ considerably. Conometridae have cirrus sockets arranged in 10 distinct, exceptionally 15 crowded, columns of 3-6 sockets, and the Atelecrinidae have cirrus sockets arranged in 10 vertical columns (15 in *Atelecrinus conifer*), each with 4-7 sockets commonly separated by interradial ridges (which may appear serrate due to projecting lateral margins of cirrus sockets), or space. The single example of Pseudoconometridae has cirrus sockets arranged in 15 columns of 7-10 sockets. Unknown in other families of the Tropiometracea, and unique to the Pseudoconometridae, are five radial pits on the centrodorsal ventral facet lacking a radial circlet. Also peculiar to Pseudoconometridae are semi-circular, concave cirrus sockets having large-diameter, circular axial canals at centre, and laterally adjacent articular tubercles. Conometrids and atelecrinids have sub-circular to circular concave cirrus sockets with small-diameter axial canals that are circular to ovoid. Pseudoconometridae, like the Conometridae, also possess a moderately large centrodorsal cavity with an overhanging peripheral edge, and a rugose cirrus-free dorsal area that is without a dorsal star.

Pseudoconometra n. gen.

Type species: *Pseudoconometra coromandelensis* Eagle.
Stratigraphic range: Duntroonian (Chattian).
Etymology: Named "pseudo" (false) for its similarity to the Conometridae.

Diagnosis. Centrodorsal high, conical with rounded cirrus-free dorsal area without dorsal star. Ventral face devoid of radial circlet, circular, with five radial pits, five indistinct basal ray furrows. Fifteen vertical columns each with 7-10 cirrus sockets possessing feeble articular tubercles. Cirrus sockets separated by radial, interradial ridges.

DESCRIPTION

Centrodorsal high, conical; ventral face roughly circular, with five large, oval radial pits 0.05 mm equidistant from peripheral edge of centrodorsal cavity. Coelomic impressions faint. Five indistinct, thick, basal ray furrows rounded proximally, terminate ovally at raised interradial points distally. Depressed subtriangular interradial areas. Large, deep, roughly subpentagonal centrodorsal cavity, 0.3 diameter of centrodorsal with overhanging edge. Large, rugose, cirrus-free dorsal area. Dorsal pole truncate-rounded, without dorsal star or impression. Steep sides of centrodorsal with 7-10 circular to ovoid, moderately deep, concave cirrus sockets. Fifteen vertical columns of closely touching cirrus sockets increase in size ventrally; laterally they are generally arranged symmetrically in opposition, separated at radial, interradial points by ridges. Cirrus sockets without articular ridge or marginal crenullae. Large round axial canal at centre. Radial circlet and cirri absent.

REMARKS

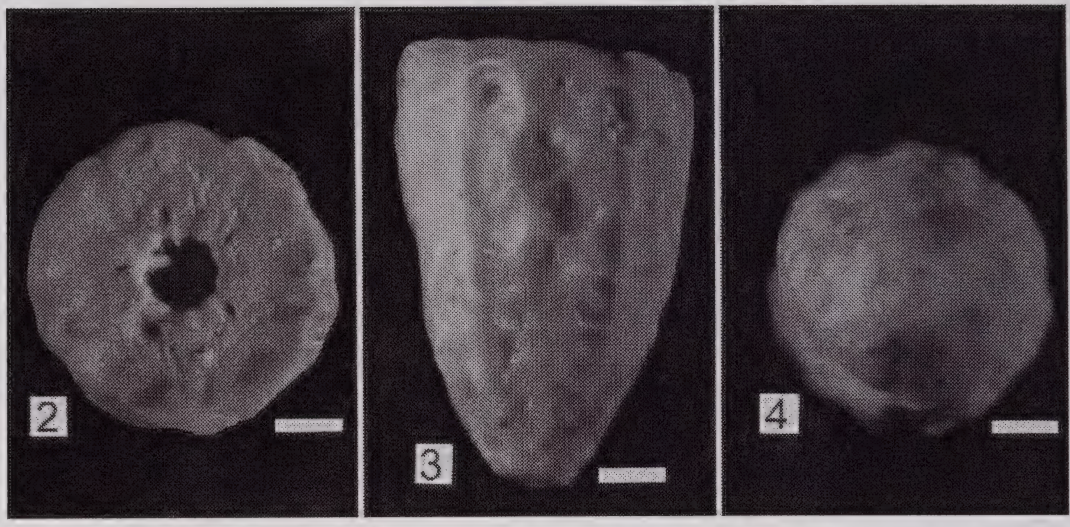
Pseudoconometra is morphologically most similar to *Conometra* (Eocene-Miocene; Europe) and *Amphorometra* (Cretaceous-Early Tertiary; Europe, Africa) of the Conometridae. Gislén (1924) distinguished the two genera by the presence or absence of a subradial cleft and whether or not basals are visible. Rasmussen (1961) regarded the arrangement of cirrus sockets as diagnostic, defining this as a character of the *Amphorometra. Conometra* has 15 vertical columns each with 4-5 cirrus sockets or 20 vertical columns with a similar number of cirrus sockets in each column; *Amphorometra* usually has only 10 vertical columns, each with 5-6 cirrus sockets. *Pseudoconometra, Conometra*, and *Amphorometra* all have cirrus sockets increasing in size toward the ventral face. Despite the radial circlet in *Pseudoconometra* being known only from faint coelomic impressions, depressed subtriangular interradial areas and indistinct basal furrows, the presence of five radial pits and arrangement of 15 vertical columns of 7-10 cirrus sockets (increasing in size upward toward the ventral face) allows confident separation from *Conometra* and *Amphorometra*. The Late Cretaceous genus *Jaekelometra* sometimes has a centrodorsal that is bluntly conical with a more or less concave ventral face, with shallow radial pits surrounding a medium sized cavity, and cirrus sockets that are also without marginal crenellae. However, *Jaekelometra* differs from *Psuedoconometra* in having a centrodorsal with fewer (3-5) cirrus sockets meeting interradially and arranged in 10 more or less distinct vertical columns. *Jaekelometra* sometimes shows a narrow, smooth lateral radial area in the upper part of the centrodorsal, which is not present in *Pseudoconometra.*

The moderately large, high-standing, conical centrodorsal with a smooth, evenly granulated, cirrus-free dorsal surface, large number and particular arrangement of cirrus sockets separated by smooth, rounded radial and interradial ridges, and a roughly circular ventral face with five radial pits surrounding a moderately large centrodorsal cavity, all serve to differentiate *Pseudoconometra* from other comatulid genera. Morphological similarities such as overall shape, cirri configuration and size, suggest that *Pseudoconometra* may have been derived from a Cretaceous conometrid such as *Amphorometra*.

Pseudoconometra coromandelensis n. sp. (Figs 2-5)

MATERIAL

Holotype. AK72847, centrodorsal cup without radial circlet or cirri. Collected by the author, November 1995 (*in situ*).



Figs 2-4. Holotype of *Pseudoconometra coromandelensis* AK72847. 2. Ventral face. 3. Lateral view. 4. Dorsal view. Scale line = 1 mm.

DESCRIPTION OF HOLOTYPE

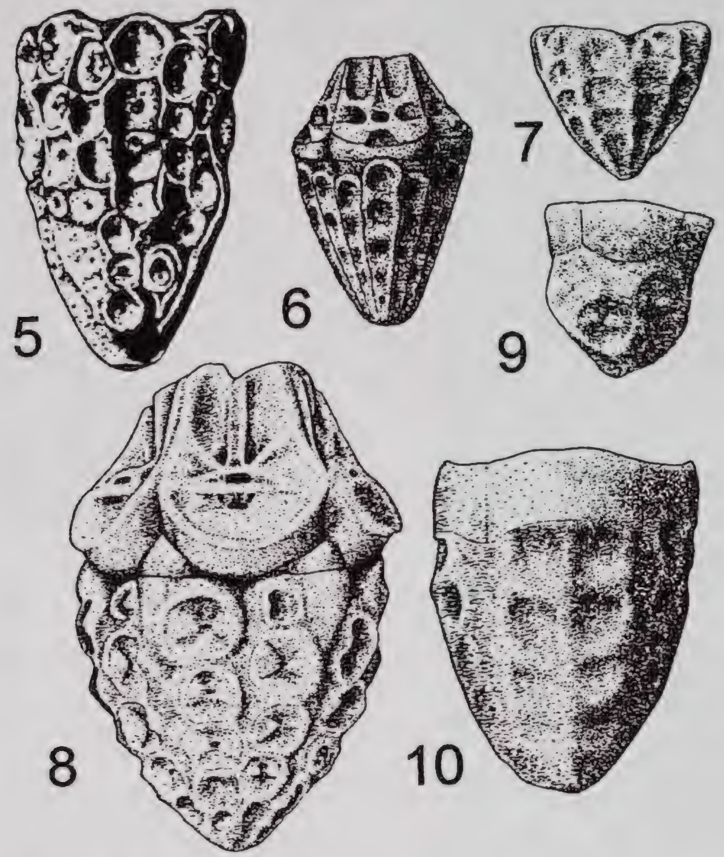
Centrodorsal high, conical; ventral facet roughly circular, irregular, rounded at edge, smooth, concave. Basal ray furrows five, indistinct, thick, with rounded ends, intersecting gently raised rim of centrodorsal cavity proximally, tapering towards raised interradial points distally. Five large, shallow, oval radial pits in surface between cavity and centrodorsal edge, 0.05 mm equidistant from cavity, located centrally in radial sections. Interradial areas raised, smooth, subtriangular. Centrodorsal cavity large, deep, roughly subpentagonal with overhanging edge, 0.3-0.4 diameter of centrodorsal. Large, smooth, cirrus-free dorsal area, dorsal pole truncate-rounded, without dorsal star or impression, granulose. Steep, inwardly sloping sides of centrodorsal covered in 15 crowded vertical columns of 7-10 closely touching, circular to subcircular, moderately deep, concave cirrus sockets, each with a central wide, deep axial pore. Axial canal at centre of two feeble articular tubercles laterally aligned. Cirrus socket margins without ornament; smooth slightly raised, rounded borders of similar height, size. Cirrus sockets increase in size ventrally, symmetrically arranged laterally in opposition. Cirrus sockets meet at radial, interradial points with no free space, separated by thick, smooth, rounded, continuous zig-zagging ridges of uniform height and size. Radial circlet, cirri unknown. Measurements (mm): centrodorsal diameter 4.6; centrodorsal height 6.7.

ETYMOLOGY

Named after the Coromandel Range and Peninsula.

REMARKS

The type species of *Conometra*, *C. alticeps* (Philippi, 1844) (Eocene, Italy; Fig. 6) is morphologically the most similar comatulid to *Pseudoconometra coromandelensis*. *C. alticeps* differs in having no radial pits, having 15 columns of 4-5 cirrus sockets (instead of the 15 columns of 7-10 cirrus sockets of *P. coromandelensis*), and in having straight radial and interradial



Figs 5-10. Illustrations (lateral views) of fossil centrodorsals most similar to *Pseudoconometra coromandelensis* (Fig. 5, x5). 6. *Conometra alticeps* (x10). 7. *Amphorometra conoideus* (x10). 8. *A. brydonei* (x10). 9. *Jaekelometra belgica* (x10). 10 *J. columnaris* (x10). [Fig. 6 from Phillipi (1844); Figs 7-10 from Rasmussen (1961).]

ridges that do not zig-zag. The type species of *Amphorometra, A. conoideus* (Goldfuss, 1840) (Late Cretaceous; Fig. 7), differs from *P. coromandelensis* by being about as high as wide, in having the centrodorsal devoid of radial pits, is covered in 10 columns each consisting of 3-5 cirrus sockets instead of the 15 columns of the 7-10 cirrus sockets of *P. coromandelensis*, and interradial rows may be separated by flat areas instead of rounded ridges as in *P. coromandelensis*. *Amphorometra brydonei* Gislén, 1924 (Fig. 8) (Late Cretaceous), another conometrid, is similar to *P. coromandelensis* but lacks radial pits, has 10 columns of 3-6 cirrus sockets, a pointed dorsal side, radial and interradial furrows between the rows of cirrus sockets, and is not as tall. The *Jaekelometra* type species, *J. belgica* (Jaekel, 1901) (Late Cretaceous; Fig. 9), is quite unlike *P. coromandelensis*, but, *J. columnaris* Gislén, 1924 (Fig. 10) has a high, conical shape with a rounded or slightly subpentagonal ventral outline. Shallow radial pits and indistinct basal furrows are also present in *columnaris* as in *P. coromandelensis,* but the centrodorsal with 10 vertical columns of 3-5 cirrus sockets symmetrically aligned laterally and meeting interradially, sometimes separated in the upper part of the centrodorsal by a wide, smooth, free radial area, is different from the new species. The arrangement of 15 columns each with 7-10 deeply concave cirrus sockets (having large, circular axial canals) symmetrically opposing one another laterally, separated by zig-zagging, smooth, rounded radial, interradial ridges and a cirrus-free dorsal area without dorsal star or impression, differentiate *P. coromandelensis* from other comatulids.

FAMILY CONOMETRIDAE Gislén, 1924

Type genus. *Conometra* Gislén, 1924.
Stratigraphic range. Late Cretaceous-Miocene.

Diagnosis. Centrodorsal conical or truncated conical having rounded or flattened dorsal area without dorsal star. Centrodorsal cavity 0.2-0.3 of centrodorsal diameter or larger. Centrodorsal lateral with 3-6 cirrus sockets increasing in size upward in 10-20 columns. Radials usually with free dorsal surface. Articular face of radials generally high, with high, narrow ventral muscular fossae surrounding narrow radial cavity. Ventral muscular fossae may be lower, wider. Radial cavity funnel-shaped, markedly widened at ventral edge (Rasmussen & Sieverts-Doreck 1978).

REMARKS

Conometridae include fossil genera resembling modern Tropiometracea in the form of the centrodorsal and radials, and in arrangement of cirrus sockets. Other forms, including the genus *Jaekelometra* were classified within the Conometridae but have been transferred to the Atelecrinidae (Rasmussen & Sieverts Doreck 1978).

Moanametra n. gen.

Type species. *Moanametra torehinaensis* n. sp.
Stratigraphic range. Duntroonian (Chattian).

Diagnosis. Centrodorsal arched conical with cirrus-free dorsal area. Two to four cirrus sockets arranged in 15 vertical columns. Basals concealed. Radial circlet $^1/_4$ as high as centrodorsal. Articular face low, wide.

DESCRIPTION

Centrodorsal arched conical with rounded, rugose, cirrus-free dorsal area without dorsal star or impression. Tiered, irregular lateral circlets of 2-4 cirrus sockets with indistinct articular ridge arranged in 15 vertical columns, increase in size orally. Basals concealed. Radial circlet $^1/_4$ as high as centrodorsal. Radial articular face low, wide; reduced ventral muscular fossae smaller than moderately deep interarticular ligament fossae with semi-elliptical ligamental pit. Radial cavity funnel-shaped, with inwardly radiating furrows directed downward toward the centre, cavity widened at ventral edge.

ETYMOLOGY

Named by combining the Maori word "moana", meaning sea or ocean, and the comatulid suffix "metra".

REMARKS

The morphology of another conometrid, *Amphorometra*, and an atelecrinid, *Jaekelometra*, is similar to that of *Moanametra*. Although centrodorsal form varies in all three genera, the major diagnostic difference between the new genus and the two existing genera, is that *Moanametra* have 2-4 cirrus sockets in 15 vertical columns covering the centrodorsal, *Amphorometra* has 3-5 cirrus sockets in 10 vertical rows, and *Jaekelometra* has 2-6 cirrus sockets in 10 vertical columns. Centrodorsal form, cirrus socket configuration, and radial circlet differences show *Moanametra* to be unlike any other comatulid.

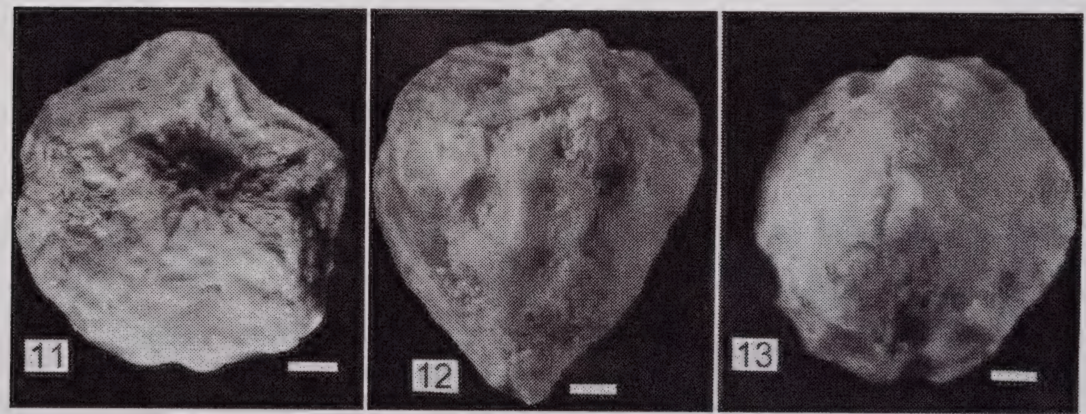
Moanametra torehinaensis n. sp. (Figs 11-14)

MATERIAL

Holotype. AK72848, centrodorsal with radial circlet, minus cirri. Collected by Geoff Gillard, 1973 (*in situ*).

DESCRIPTION OF HOLOTYPE

Centrodorsal arched, conical, with rounded, rugose, cirrus-free dorsal area. Centrodorsal with inwardly sloping sides covered with tiered, irregular, lateral circlets of 2-4 circular sockets decreasing in size dorsally, arranged in 15 vertical columns. Cirrus sockets small, moderately concave, with central narrow axial canal, indistinct articular ridge, and smooth margins without ornament. Interradial ridges of uniform height, smooth, rounded. Radial showing median zig-zag prolongation into uppermost uneven circle of cirrus sockets where they terminate. Basals concealed at interradial points. Radial circlet stellate in outline ventrally, laterally $^1/_4$ as high as centrodorsal, with edges turned inside edge of centrodorsal periphery, and adoral grooves intersecting calyx radial cavity. Radial external free facet reduced; dorsal ligament fossae semi-elliptical, deep. External edge of dorsal ligament a high, narrow lip thickened at dorsal extremity; occasionally touching cirrus sockets; extending in reducing form to junction of radial septum. Articular face of radials low, wide. Synarthrial articulation of missing brachials established by straight, thick transverse ridge broken mid-way by a deep, semi-circular central axial canal aperture sited above deep, ovoid, ligamental pit. Transverse ridge junction reaches interradial septum half-way above centrodorsal. Dorsal ligament fossae low, about $^1/_{10}$ theca height, larger than muscular fossae. Muscular fossae low, confined beneath interradial edge of articular face of radials, forming almost horizontal linear bands at ventral extremity, curved downwards along radial septum adjoining moderately wide midradial furrow; ventral edge slightly curved with



Figs 11-13. Holotype of *Moanametra torehinaensis* AK72848. 11. Ventral face. 12. Lateral view. 13. Dorsal view. Scale line = 1 mm.

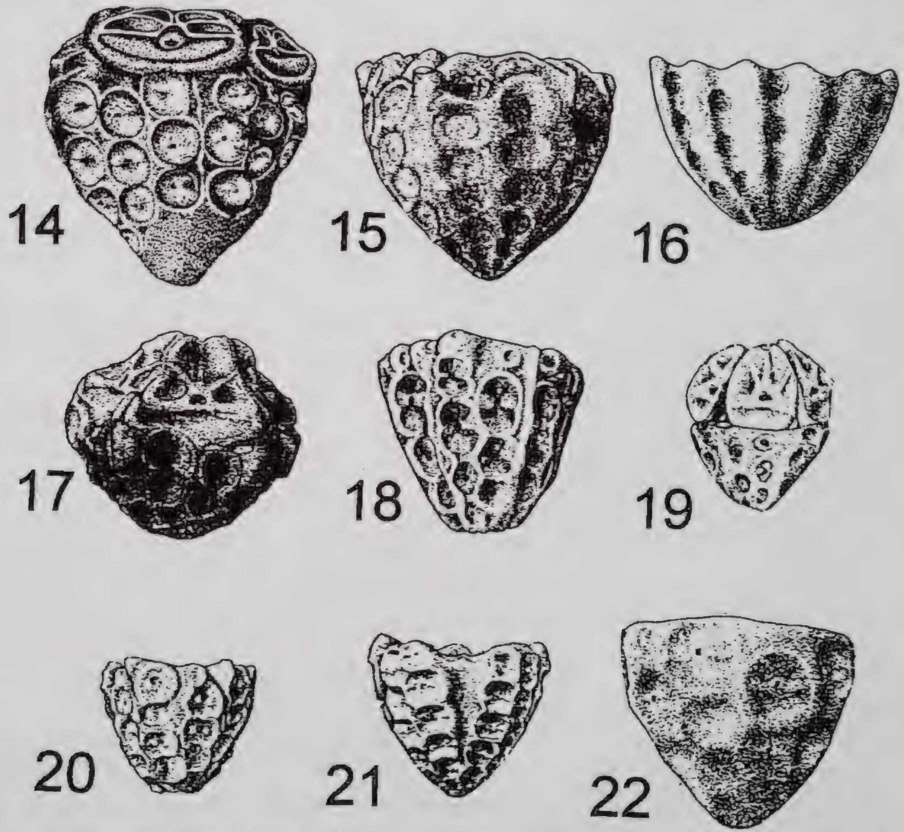
median notch. Radial rossette collapses deeply inward at centrodorsal cavity; five large radial furrows, 20 distinct but smaller interradial furrows inwardly sloping downward into theca radial cavity centre. Basals concealed. Theca radial cavity broadly circular, about $^1/_3$ diameter of centrodorsal. Radial cavity narrow. Measurements (mm): calyx diameter 8.2; theca height 8.9; centrodorsal height 6.2; external height of free radial face 0.3; radial facet length 2.4; radial facet width 3.9; inclination of radial facet 43 degrees.

ETYMOLOGY

Named after the Torehina Formation.

REMARKS

Another conometrid genus, *Amphorometra*, includes several species that are morphologically similar to *Moanametra torehinaensis*. The new species has 2-4 cirrus sockets in 15 vertical rows covering the centrodorsal, while *Amphorometra* species have 3-6 cirrus sockets in 10 vertical columns. Other characteristics (low radial facet, lack of defined interradial ridge) differentiate *Moanametra torehinaensis* from *Amphorometra*. Cretaceous species, including the type



Figs 14-22. Illustrations (lateral views) of fossil centrodorsals most similar to *Moanametra torehinaensis* (Fig. 14, x10). 15. *Amphorometra bruennichi* (x10). 16. *A bellilensis* (x5). 17. *A. semiglobularis* (x10). 18. *A. pyropa* (x10). 19. *A. rugiana* (x10). 20. *A. parva* (x10). 21. *Jaekelometra meijeri* (x5). 22. *J. concava* (x10). [Figs 15-22 from Rasmussen (1961).]

Amphorometra connoideus (Fig. 7), are similar to *Moanametra torehinaensis* but differ in form; their centrodorsals are of similar shape and size, but *Amphorometra* usually have straight, vertical interradial ridges or free space between columns of cirrus sockets. Compared to *M. torehinaensis* the centrodorsal of *A. connoideus* is subpentagonal instead of roughly circular, has a much larger centrodorsal cavity, possesses distally enlarging basal furrows, and has broader, ovate (rather than circular) cirrus sockets. The centrodorsal face of *A. bruennichi* (Rosenkrantz, 1944) (Fig. 15), is subpentagonal to roughly stellate compared with the roughly circular shape of *M. torehinaensis*. *A. bruennichi* further differs from *M. torehinaensis* in having a centrodorsal cavity that is subpentagonal, possesses interradial and radial ridges that are not as wide but are higher and more broadly rounded, and has more overlapping interradial points with markedly embayed centrodorsal interradial edges and pronounced radial ridges.

The thecae of *A. brydonei* (Fig. 8) possess a similar conical centrodorsal to that of *M. torehinaesis*, but have larger interradial points, and no cirrus-free dorsal area. Instead of the raised, rounded radial and interradial ridges of *M. torehinaensis*, *A. brydonei* has larger cirri sockets with marginal, raised rounded lips that form the radial and interradial ridges. *A. bellilensis* (Vallette, 1935) (Fig. 16), has a more roundly arched centrodorsal than *M. torehinaensis*, with no cirrus-free dorsal area. The centrodorsal of the thecae of *A. semiglobularis* (Nielsen, 1913) (Fig. 17), differs from *M. torehinaensis* by being roundly arched instead of conical, is ventrally subpentalobate with projecting interradial points, has broad, truncated oval to circular cirrus sockets in irregular vertical columns of five with a small, pustulose, cirrus-free dorsal area, and radial muscular fossae that are higher in *M. torehinensis*.

The centrodorsal of *A. pyropa* (Zahalka, 1832) (Fig. 18), is truncated conical and not as rounded-conical nor as long as in *M. torehinaensis*. The centrodorsal ventral face of *A. pyropa* is more oblong to subcircular than in *M. torehinaensis*, has thin basal furrows that enlarge distally instead of tapering, and has rounded, irregular radial impressions which is lacking in *M. torehinaensis*. Radial and interradial lateral ridges are higher, more sharply defined in *A. pyropa* than in *M. torehinaensis*, and instead of a cirrus-free dorsal area there is a dorsal pit. The centrodorsal of the thecae of *A. rugiana* (Gislén, 1924) (Fig. 19), differs from that of *M. torehinaensis* by being shorter, more sharply conical, with fewer cirrus sockets and by not having a cirrus-free dorsal area. The centrodorsal of *A. parva* (Gislén, 1924) (Fig. 20), is truncated conical, considerably shorter in length, with broader basal furrows than in *M. torehinaensis*. It is embayed at the radial edge, has a much larger centrodorsal cavity, possesses rugose radial and interradial ridges that are irregular, not straight, and has a flat not conical cirrus-free dorsal area.

Morphology of the Late Cretaceous atelecrinids *Jaekelometra meijeri* Rasmussen, 1961 (Fig. 21) and *J. concava* (Schlüter, 1878) (Fig. 22) is similar to that of *M. torehinaensis*. Both species described by Rasmussen (1961) have conical centrodorsals, similar sized, semi-circular to circular cirrus sockets bordered by zig-zagging radial and interradial ridges as in *M. torehinaensis*. However, they also have 10 columns of 2-6 cirrus sockets, which separates them from *M. torehinaensis*.

M. torehinaensis differs from other comatulids by having a centrodorsal that is not embayed at the radial periphery, has a moderate, subcircular, centrodorsal cavity on the ventral face, has indistinct broad basal furrows that do not change size distally. The centrodorsal possesses vertical irregular radial and interradial ridges that are broadly rounded, separating 15 columns of 2-4 circular cirrus sockets arranged regularly in lateral circlets, increasing in size toward the radials.

DISCUSSION

Well preserved, entire fossil comatulid specimens are unknown in New Zealand. In addition to those in the Torehina Formation, many comatulid centrodorsals have been collected from shallow water Oligocene limestone localities in the South Island (Eagle, unpublished), all in association with benthic pelmatazoans. Unlike the endemic species described in this paper, known South Island genera have a largely Tethyan affinity. The occurrence of two New Zealand Cenozoic tropiometraceans living with stalked crinoids in a shallow, innershelf environment (no more than 30 m deep), conflicts with the fossil record elsewhere in the world. Northern hemisphere models (Bottijer & Jablonski 1988) suggesting stalked crinoid movement offshore to deeper water in the Triassic, are contrasted by the inner-shelf late Oligocene comatulid-pelmatazoan association at Waitete Bay (Eagle 1993). The Waitete Bay comatulid taxa may simply be opportunistic as a result of climate warming, Indo-Pacific inward migration, the regional late Oligocene marine transgressive sequence, radiation within a New Zealand refugium, a response to tiered feeding within an ecological niche, or a combination of these. Whatever the cause, these comatulids are the remains of an unusual crinoid community selectively preserved within the limestone biofacies. In the context of New Zealand crinoid evolution, the fauna is important for several reasons. Both species described here belong to a superfamily today found in warm waters of the Pacific Ocean, with possible direct evolutionary relations. The Waitete Bay taxa are so far, the only recorded evidence of fossil comatulid communities in New Zealand.

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